DOCUMENT RESUME

ED 125 483 HE 008 067

AUTHOR	Alley, William E.; Berberich, George L.
TITLE	A Procedure for Estimating Enrollment and Cost Factors at Potential AFROTC Host-Sites.
INSTITUTION	Air Force Human Resources Lab., Lackland AFB, Tex. Personnel Research Div.
REPORT NO	AFHRL-TR-75-76
PUB DATE	Dec 75
NOTE	14p.
AVAILABLE FROM	HQ. Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235
EDRS PRICE	MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS	*Cost Effectiveness; *Educational Facilities; Enrollment Projections; Environmental Influences; *Higher Education; *Military Personnel; *Military Training; Operating Expenses; Organizational Effectiveness; Statistical Analysis; *Student Enrollment
IDENTIFIERS	AFROTC; *Air Force Reserve Officer Training Corps

ABSTRACT

The development of effectiveness criteria for AFROTC detachments, and relationships between the criteria and various environmental and program characteristics are described. The objective of the study is the development of a method for estimating student enrollments and total operating costs at perspective host-site institutions by using institutional measures which can be easily updated. Standard multiple regression techniques are used in the analysis. The predictors were chosen for their high validity and their easy access in an operational setting. Utilizing the equations and procedures set forth in the report, cost and enrollment figures can be derived for potential AFROTC host sites. (Author/JMF)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

AFHRL-TR-75-76

AIR FORCE HUMAN RESOURCES LABORATORY

ED125483

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

A PROCEDURE FOR ESTIMATING ENROLLMENT AND COST FACTORS AT POTENTIAL AFROTC HOST-SITES

By

William E. Alley
George L. Berberich, A1C, USAF

PERSONNEL RESEARCH DIVISION
Lackland Air Force Base, Texas 78236

December 1975
Interim Report for Period February 1975 – June 1975

Approved for public release; distribution unlimited.

HE 00 8067

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

NOTICE

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This interim report was submitted by Personnel Research Division, Air Force Human Resources Laboratory, Lackland Air Force Base, Texas 78236, under project 7719, with Hq Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235. William E. Alley, Personnel Research Division, was the project monitor.

This report has been reviewed and cleared for open publication and/or public release by the appropriate Office of Information (OI) in accordance with AFR 190-17 and DoDD 5230.9. There is no objection to unlimited distribution of this report to the public at large, or by DDC to the National Technical Information Service (NTIS).

This technical report has been reviewed and is approved.

LELAND D. BROKAW, Technical Director
Personnel Research Division

Approved for publication.

HAROLD E. FISCHER, Colonel, USAF
Commander

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AFHRL-TR-75-76
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): A PROCEDURE FOR ESTIMATING ENROLLMENT AND COST FACTORS AT POTENTIAL AFROTC HOST-SITES

5. TYPE OF REPORT & PERIOD COVERED: Interim, February 1975 -- June 1975

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): William E. Alley, George L. Berberich

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Personnel Research Division, Air Force Human Resources Laboratory, Lackland Air Force Base, Texas 78236

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 62703F, 77190243

11. CONTROLLING OFFICE NAME AND ADDRESS: Hq Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235

12. REPORT DATE: December 1975

13. NUMBER OF PAGES: 14

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report): Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report):

18. SUPPLEMENTARY NOTES:

19. KEY WORDS (Continue on reverse side if necessary and identify by block number):
AFROTC
organizational effectiveness
environmental characteristics
institutional research
regression analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number):

This report is one of a series describing (a) the development of effectiveness criteria for AFROTC detachments, and (b) relationships between the criteria and various environmental and program characteristics. The objective of this report was to develop a method for estimating student enrollments and total operating costs at perspective host-site institutions by using institutional measures which were easily updated. Standard multiple regression techniques were used in the analysis. The predictors were chosen for their high validity and their easy access in an operational setting. Utilizing the equations and procedures set forth in the report, cost and enrollment figures can be derived for potential AFROTC host-sites.

PREFACE

This research was conducted under Project 7719, Air Force Personnel System Development on Selection, Assignment, Evaluation, Quality Control, Retention, Promotion, and Utilization; Task, 771902, Exploration of Methods for Increasing the Effectiveness of Personnel Programs. The investigation was made in partial response to RPR 73-40; Prediction of AFROTC Detachment Viability, originating at AFROTC/ACME.

TABLE OF CONTENTS

		Page
I.	Introduction	5
II.	Approach	5
III.	Model Specifications	6
IV.	Discussion	6
V.	Illustration	10
VI.	Conclusions/Recommendations	10
References		12

LIST OF ILLUSTRATIONS

Figure		Page
1	Estimating AS 300 enrollments on the basis of host-site male enrollment, control and location data	11

LIST OF TABLES

Table		Page
1	Institutional Characteristics	5
2	Definition of Predictor Variables Selected for Final Equations	7
3	Means, Standard Deviations, Zero-Order and Composite Validities for Selected Predictors (N=150)	8
4	Final Regression Equations	9

A PROCEDURE FOR ESTIMATING ENROLLMENT AND COST FACTORS AT POTENTIAL AFROTC HOST-SITES

I. INTRODUCTION

The objective of this research was to develop a method for estimating student enrollments and total operating costs at prospective Air Force Reserve Officer Training Corps (AFROTC) host-site institutions that would be both reasonably accurate and simple to implement. Initial efforts in this area documented by Alley and Berberich (1975) indicated substantial relationships between various measures of detachment performance and characteristics of the host college. For practical purposes, however, some of the predictor variables used in that study were of limited value, either because they were unavailable for certain schools or were difficult to update on a periodic basis. In response to immediate requirements outlined by Hq AFROTC for an operational prediction system, the feasibility of revising the predictor base was explored with the intent of converting to more readily accessible institutional measures while maintaining the accuracy of estimation obtained in the earlier study.

II. APPROACH

The initial pool of predictor variables included in the analysis is shown in Table 1. The information was obtained from three standard reference books available in most academic libraries: (a) American Universities and Colleges (10th ed, American Council on Education, 1968); (b) The College Blue Book (14th ed, CCM Information Corporation, 1972); and (c) Earned Degrees Conferred (1970–71, National Center for Educational Statistics, 1973).

Table 1. **Institutional Characteristics**

Variables	Format	Source
Total Male Enrollment (Undergrad)	Literal	American Council on Education
Total Female Enrollment (Undergrad)	Literal	American Council on Education
Total Graduate Enrollment	Literal	American Council on Education
Average ACT Composite	Literal	American Council on Education
Total PhDs Awarded	Literal	American Council on Education
Total Undergraduate Scholarships	Literal	American Council on Education
Average Worth of Undergrad Scholarships	Literal	American Council on Education
Total Full-Time Teaching Staff	Literal	American Council on Education
Total Number of Library Volumes	Literal	American Council on Education
Total Revenues	Literal	American Council on Education
Total Revenues from Tuition & Fees	Literal	American Council on Education
Collocated ROTC Units	Categorical (2)	American Council on Education
Institutional Type	Categorical (4)	American Council on Education
Institutional Control	Categorical (2)	American Council on Education
Institutional Religious Affliation	Categorical (3)	American Council on Education
Land Grant Status	Categorical (2)	American Council on Education
Geographic Region	Categorical (8)	College Blue Book
Pct. Black Enrollment	Literal	College Blue Book
Students per Faculty Member	Literal	College Blue Book
Degrees Awarded in 24 Selected Areas	Literal	Office of Education (HEW)

The criterion variables of principal interest were student enrollments in Air Science (AS) 300 and total detachment operating costs (excluding funds associated with the college scholarship and flight instruction programs). To insure stability in these measures, enrollment and cost data for the two most recent school years were averaged and the composites used in the actual analysis.

Individual detachments constituted the sampling units. To be included in the analysis sample, a detachment had to have been in continuous operation for at least five years and must have offered AFROTC training on an optional rather than a compulsory basis. In total, approximately 150 detachments met the dual standard for inclusion.

After the data were assembled into computerized format for all valid detachments, a standard multiple regression analysis was performed to select and weight the predictor variables appropriately. In these exercises, institutional measures which did not contribute uniquely to predicting either the enrollment or cost criteria were subsequently dropped from the final equations.

For each criterion, two models were developed. The first permitted information about degree orientations to enter the equations while the second did not. Of all the predictor variables, the data on degrees awarded in selected areas was the most time-consuming to obtain from a clerical standpoint. Thus, serviceable predictions were desired both including and excluding this information.

III. MODEL SPECIFICATIONS

Variables selected from those contained in the initial pool, as providing the most accurate composite predictions of AS 300 enrollment and total detachment costs, are listed in Table 2 with associated coding definitions. The accuracy of the final equations is summarized in Table 3 which also shows means, standard deviations, and zero-order correlations between selected variables and the criteria. A composite validity of .65 was obtained in predicting AS 300 enrollments, accounting for approximately 42% of the criterion variance. A restricted model excluding degree orientation data yielded a correlation of .63. Similar validities were noted for equations predicting total detachment costs where the full and restricted models yielded correlations of .64 and .62. Each of the four coefficients was statistically significant beyond the .01 level. However, in neither case did degree orientations add significantly to prediction when considered in the context of the other variables. Raw score regression weights for predictor variables included in the final equations are shown in Table 4.

IV. DISCUSSION

Results from this analysis suggest that an appreciable amount of the variance in AS 300 enrollments and total detachment costs can be accounted for by considering various characteristics of the host college at which the detachments are located. These would include geographic region, total school enrollments, proportion of male enrollments, students per faculty member, institutional type and public versus private control. Degree orientation data as defined in this study appears to be more or less redundant with the other more readily accessible information just described. For practical purposes, the restricted models excluding the degree data yield equivalent predictions with greater efficiency; especially in view of the clerical processing needed to retrieve the number and proportion of degrees awarded.

The accuracy of prediction associated with both the enrollment and cost models compares quite favorably with that obtained in prior analyses. Previously, correlations of .71 and .75 had been reported using approximately 30 independent predictors and a single year of enrollment and cost data (Alley & Berberich, 1975). Some shrinkage was expected due to the fact that 2-year composite criteria were used and that only 26 of the revised predictors had been retained for simplicity of implementation.

Table 2. **Definition of Predictor Variables Selected for Final Equations**

Variable	Definition
Total Male Enrollment	Literal coding format. Includes the total number of full-time male undergraduate enrollments.
Total Enrollment	Literal coding format. Includes the total number of full-time male and female enrollments at the undergraduate and graduate levels.
Average ACT Composite	Literal coding format. This number reflects the average ACT composite for entering freshmen. For schools at which the SAT mathematics and verbal scores only are available, reference is made to conversion tables found in Alexander Astin's, *Predicting Academic Performance in College*, American Council on Education, 1971.
Students Per Faculty Member	Literal coding format. Obtained by dividing the total enrollment by the total full-time faculty.
Geographic Region	Categorically coded 1 if applicable; Ø otherwise. States included in each region are listed below.
New England	CT, ME, MA, NH, RI, and VT
Mid East	NY, PA, NJ, DE, MD, WV, and DC
Great Lakes	OH, IN, MI, IL, WI, and MN
Plains	ND, SD, NB, IA, MO, and KS
South East	VA, NC, SC, GA, FL, AL, TN, MS, AR, LA, and KY
South West	TX, OK, NM, and AZ
Rocky Mtns	MT, WY, CO, UT, and ID
Far West	NV, CA, OR, WA, HI, and AK
Institutional Type	Categorically coded 1 if applicable; Ø otherwise.
University	
Liberal Arts College	
Teachers College	
Technical Institute	
Public Control	Categorically coded 1 if the institution is under public control; Ø if private.
Predominantly Male	Categorically coded 1 if the percentage of males in the undergraduate student body is greater than 75%; Ø if predominantly coed. Note that this variable does not include provisions for predominantly female institutions since at no time have AFROTC detachments operated in this type of environment.
Predominantly Black	Categorically coded 1 if the percentage of black enrollments is greater than 75%; Ø otherwise.
Collocated ROTC	Categorically coded 1 if the institution does not presently offer an ROTC program of any type; Ø if either the Army, Navy or both are represented.
Degree Orientation	Literal coding format. Represents the total percentage of degrees offered in 24 specialties grouped into seven broad areas. Career fields included in each area are listed below. Note: Totals add to 100%.
Realistic	Agriculture, Architecture, Engineering, Geology
Scientific	Biology, Computer Sciences, Mathematics, Physical Science
Social	Education, Health, Psychology, Social Sciences
Conventional	Business, Home Economics
Enterprising	Area Studies, Banking and Finance, Law, Economics, History, Political Science
Artistic	Fine and Applied Arts, Foreign Languages, Letters
Aerospace	Aerospace Engineering

Table 3. **Means, Standard Deviations, Zero-Order and Composite Validities for Selected Predictors (N=150)**

Variable	Mean	SD	Correlations	
			AS 300 Enr	Total Det Cost (Exc)
Total Male Enrollment	5346	4029	.35	.36
Total Enrollment	10236	8464	.27	.25
Avg ACT Composite	23.62	2.77	−.22	−.20
Students Per Faculty Member	14	7	.08	.05
Geographic Region				
New England	.047	.21	−.15	−.15
Mid East	.134	.34	−.19	−.13
Great Lakes	.174	.38	−.16	−.10
Plains	.121	.33	−.08	−.02
South East	.235	.43	.15	.24
South West	.107	.31	.27	.19
Rocky Mtns.	.060	.24	.07	.04
Far West	.121	.33	.06	−.14
Institutuional Type				
University	.691	.46	.14	.21
Lib Arts College	.214	.41	−.13	−.24
Teachers College	.040	.20	−.05	−.07
Technical Inst	.053	.23	−.02	.07
Public Control (1=Public)	.644	.48	.41	.39
Predom Male (1=Male)	.195	.40	−.01	.07
Predom Black (1=Black)	.027	.16	−.05	−.07
Collocated ROTC (1=None)	.550	.50	−.11	−.09
Degree Orientation				
Realistic	14.849	16.89	.19	.22
Scientific	11.110	6.22	−.22	−.17
Social	30.367	13.60	.00	−.07
Conventional	15.600	8.58	.23	.27
Enterprising	13.372	8.53	−.21	−.1[illegible]
Artistic	14.178	7.95	−.27	−.32
Aerospace	.495	1.06	.20	.23
Composite Validity (R)				
(a) W/Degree Orientations			.65**	.64**
(b) W/O Degree Orientations			.63**	.62**

**Statistically significant beyond the .01 level.

Table 4. **Final Regression Equations**

Variable	Regression Weights			
	AS 300 Enrollment		Total Det. Cost (Exc)	
	W/O Degrees	W Degrees	W/O Degrees	W Degrees
Total Male Enrollment	.00391	.00305	11.15475	8.87206
Total Enrollment	−.00126	−.00088	−3.48417	−2.59997
Avg ACT Composite	−.91666	−1.08260	−4506.07812	−5557.44568
Students Per Faculty	.14325	.13898	715.59403	646.71914
Geographic Region				
New England	−.73550	−.27516	−7378.96747	−12642.57251
Mid East	.54252	.78659	389.23394	690.22260
Great Lakes	−1.93683	.00000	−11749.90173	−7794.72571
Plains	.00000	1.17916	−2546.30753	−1512.88818
South East	6.57687	7.14121	17243.24121	12925.65479
South West	15.48333	15.50517	18299.45972	13366.16833
Rocky Mtns.	8.17501	8.53507	4363.28333	3447.95981
Far West	12.02718	12.84212	.00000	.00000
Institutional Type				
University	−2.44785	.10421	8987.13703	−14609.28601
Lib Arts College	.92576	4.88511	.00000	−24054.63292
Teachers College	−10.11856	−3.97059	−22882.61230	−37861.93018
Technical Inst	.00000	.00000	29570.76807	.00000
Public Control (1=Public)	5.06417	3.44808	8905.19043	8793.59570
Predom Male (1=Male)	3.97086	−.68808	16167.75671	−1949.86902
Predom Black (1-Black)	−8.33948	−11.30723	−43134.59033	−54911.64648
Collocated ROTC (1=None)	−1.27049	−2.06776	5262.61475	2800.20331
Degree Orientation				
Realistic		.21100		.00000
Scientific		−.07400		−29.16100
Social		.00000		−622.33900
Conventional		.16300		346.00700
Enterprising		.26200		708.29200
Artistic		−.07100		−791.96900
Aerospace		1.68800		4856.17400
Constant	30.25422	25.54716	166028.30000	238170.76000

It is interesting to note the measures which did not appear to contribute uniquely to predictive accuracy in the context of those selected. Variables dropped from the system included female enrollments, total number of PhDs awarded, number of undergraduates on scholarship, average worth of undergraduate scholarships, total number of full-time faculty members, number of library volumes, and miscellaneous revenue data. Similarly, religious affiliation and land-grant status were shown to provide little in the way of incremental validity. This does not imply that these factors taken individually were unrelated to the criteria; only that any predictability associated with them was shared in common with one or more of the variables selected for the models. The same might be said for the degree orientation variables which, in these analyses, did not contribute significantly to predictive accuracy.

As noted in previous studies (Alley, 1974; Alley & Berberich, 1975), there appears to be some similiarity between the enrollment and total cost prediction systems. This may be attributable to the fact that certain components of the total cost estimates vary proportionally with the number of cadets enrolled in the program.

V. ILLUSTRATION

Since it is sometimes difficult to conceptualize the combined effect of a large number of variables weighted simultaneously in a prediction model, some additional insight into the procedure used might be gained by reviewing the characteristics of a simpler model. Suppose that only three items of information were available about a potential host-site: (a) the total number of male enrollments, (b) whether it was under public versus private control, and (c) whether or not it was located in the Southwest. The general form of a regression equation utilizing this information might be as follows:

$$\hat{Y} = C + a_1 X^1 + a_2 X^2 + a_3 X^3 \text{ where}$$

Y = the criterion of interest (e.g., AS 300 enrollments)

C = a constant term

X^1 = the number of male enrollments

X^2 = 1 if the institution is publicly controlled; 0 otherwise

X^3 = 1 if the institution is located in the Southwest; 0 otherwise

$a_1 - a_3$ unknown least-squares regression weights

The coefficients $a_1 - a_3$ are estimated by observing the effects of the three predictor variables on AS 300 enrollments at current operational detachments. Moreover, the values associated with $a_1 - a_3$ are such that no other values would provide more accurate predictions. The next equation shows the values of $a_1 - a_3$ as computed on the analysis sample (R = .50).

$$\hat{Y} = 12.73 + (.00076)X^1 + (10.22)X^2 + (12.55)X^3$$

By generalizing to schools which do not yet host detachments, it would be possible to estimate the expected AS 300 enrollments. If, for example, a candidate school had a total of 15,000 male enrollees, was privately controlled, and was located in the Southwest, the best estimate of its expected AS 300 enrollment would be:

$$\hat{Y} = 12.73 + (.0076)(15000) + 10.22(0) + (12.55)(1) \text{ or}$$
$$\hat{Y} = 37$$

The relationships identified in this equation are shown graphically in Figure 1. The procedure for estimating the joint influence of 26 predictor variables (as opposed to 3) would be identical in both analytical form and subsequent applications.

VI. CONCLUSIONS/RECOMMENDATIONS

These analyses support the technical feasibility of establishing an objective, quantifiable procedure for evaluating any potential host-site institution. It is recommended that a data file be assembled containing all schools in which it might be desirable to establish an AFROTC detachment. Information for each school would include but not necessarily be limited to those measures specified in Table 2. The selection process could then be supplemented with expected enrollment and total cost data based on past experience with similar institutions.

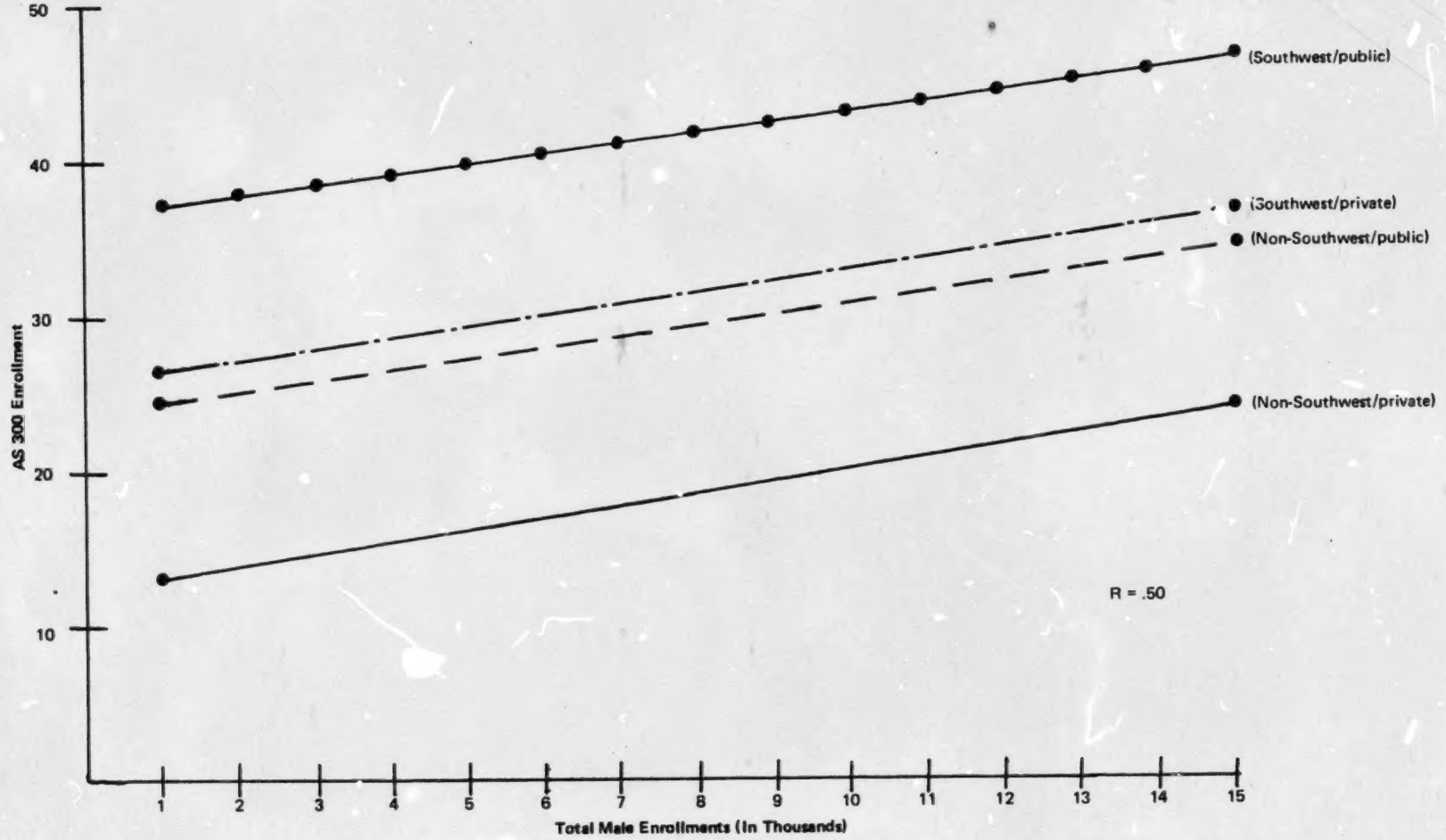

Figure 1. **Estimating AS 300 enrollments on the basis of host-site male enrollment, control and location data.**

REFERENCES

Alley, W.E. *Development of a data base for AFROTC management analysis–1973 update.* AFHRL-TR-73-74, AD-779 774. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, February 1974.

Alley, W.E., & Berberich, G.L. *An Analysis of AFROTC detachment viability.* AFHRL-TR-75-18, AD-A017 797. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, February 1975.

American Council on Education. *American universities and colleges* (10th ed.). In O.A. Singletary (Ed.), Washington, D.C.: 1968.

Astin, A.W. *Predicting academic performance in college.* New York: The Free Press, 1971.

CCM Information Corporation. *The college blue book, US colleges: tabular data,* (14th ed.). New York: author, 1972.

National Center for Educational Statistics. *Earned degrees conferred 1970–71.* Washington: Office of Education, 1973.

12 ☆U.S. GOVERNMENT PRINTING OFFICE: 1976-671-613/33